

## REMARKS

Claims 1, 4-6, 10, 13-15, 18, 19, and 26-28 are all of the claims presently pending.  
Claims 2, 3, 7-9, 11, 12, 16, 17, and 20-25 are canceled.

It is noted that Applicants specifically state that no amendment to any claim herein, if any, should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claims or of the claims canceled for purpose of expediting prosecution of these claims indicated as being allowable.

Claims 1, 4-6, 10, 13-15, 18, 19, and 26-28 stand rejected under 35 U.S.C. § 101 as allegedly directed to non-statutory subject matter.

Applicants gratefully acknowledge the Examiner's indication that the claim revisions have overcome the previous prior art rejection based on US Patent No 6,601,080 to Garg.

### I. THE CLAIMED INVENTION

As exemplarily defined in independent claim 1, the claimed invention is directed to a method to at least one of reduce a memory space requirement and to increase a processing efficiency in a computerized method of linear algebra processing. A hybrid full-packed data structure is provided for processing data of a triangular matrix by one or more dense linear algebra (DLA) matrix subroutines designed to process matrix data in a full format, as modified to process matrix data using the hybrid full-packed data structure. Data is converted from the triangular matrix into the hybrid full-packed data structure by: determining a portion of the triangular matrix data that would comprise a square portion having a dimension approximately one half a dimension of the triangular matrix data; fitting a first triangular portion of the triangular matrix data into a first location relative to data of the square portion; and fitting a second triangular portion of the triangular matrix data into a second location relative to data of the square portion, wherein the first triangular portion, the second triangular portion, and the square portion fit together to form the rectangular data structure. The hybrid full-packed data structure provides a rectangular full format data structure for an entirety of the triangular matrix data and the triangular matrix comprises a triangular or symmetric/Hermitian matrix.

As explained on lines 9-16 of page 10 of the specification, the conventional dense linear algebra (DLA) data structures for triangular matrix data subroutines will either provide compact data storage along with slow processing speed or, alternatively, will provide faster processing speed but increased storage requirement.

In contrast, the present invention provides a method so that both compact storage and the faster processing speed are available. That is, the hybrid full-packed data structure taught by the present invention provides a full format storage of triangular matrix data that can be processed by the faster full-format subroutines, as modified to process this new rectangular data structure.

## II. THE 35 USC §101 REJECTION

The Examiner continues to maintain the non-statutory subject matter rejection for all pending claims. In paragraph 7 beginning on page 3 of the Office Action, the Examiner responds to Applicants' arguments, as follows:

*"The examiner respectfully submits that the reduction in memory is an intended use of the method of converting to full-packed structured data. It is not a necessary specific practical application of the method. It is not a practical application nor tangible final result of calculation. In general, the claims are drafted so broadly to preempt every substantial practical application of the idea embodied by the claim which is covering the triangular matrix into the rectangular matrix for processing and there is nothing in the claims that breathes sufficient life and meaning into the preamble so as to limit it to a particular practical application rather than being so broad and sweeping as to cover every substantial practical application of the idea embodied therein."*

In response, Applicants respectfully submit that the above-recited rationale by the Examiner includes a number of points of confusion relative to patent law and statutory subject matter.

First, relative to the characterization that "... the claims are drafted so broadly to preempt every substantial practical application of the idea embodied by the claim which is covering the triangular matrix into the rectangular matrix for processing ....", Applicants point out that all patent claims inherently preempt something.

In the present invention and taking claim 1 as an example, the claims are intended to provide patent protection for the method of reducing memory space and increase processing efficiency as that method is then defined in the claim limitations. More specifically, Applicants

have recognized that triangular matrix data, as conventionally stored in memory, takes up more memory than necessary to preserve the information and causes processing inefficiency by requiring that the redundant information also be processed. The inventors realized that the essential data, which is triangular-shaped from the perspective of matrices, could be stored in a novel rectangular format of about one half size of the original complete matrix data and could be processed faster if only this essential data is presented for processing, as long as the processing keeps track of how the essential data has been reorganized in memory and the matrix subroutines are modified for the novel data structure.

The only thing preempted by the present invention is a specifically-defined method of reducing memory and increasing processing efficiency for matrix processing, only for triangular/symmetrical matrix data, and only when done by the preliminary conversion of triangular or symmetrical matrix data into the novel rectangular format as being the method.

There is no preemption of normal processing of matrix data stored in the conventional full format. There is no preemption of processing of triangular/symmetrical matrix data using the conventional storage that takes up more memory and is inefficient.

Applicants submit that the Examiner's confusion with "preemption" is perhaps related to the misunderstanding that all patents are inherently intended to preempt something. That "something" depends upon the object and environment of the invention and different inventions require different wording to provide protection. The "something" of the present invention is related to the machine doing the matrix processing by its prearranging of the input data.

In contrast, the "preemption" in modern patent law is whether a mathematical algorithm is being preempted. It is not directed to the exclusive use of a method in all applications, as the Examiner perceives, since such exclusive use is actually the intent of granting a patent.

In the present invention, there is no mathematical algorithm being claimed, since the method relates to a preliminary reorganizing of triangular/symmetrical matrix data originally stored in a conventional manner. The method of the present invention is a preliminary reorganization of input data, not a mathematical algorithm, and the present invention does not preempt a mathematical algorithm even if there were dependent claims directed to the matrix processing itself, since the underlying "mathematical algorithm" (e.g., the matrix procedure, if this is considered to be a "mathematical algorithm") can still be executed using the originally-

stored data and the original matrix subroutines. Moreover, there are no claims directed to processing the matrix operation itself, even if such matrix operation were to be considered a mathematical algorithm.

Relative to the Examiner's position that the claims must limit the method to a specific application, Applicants respectfully disagree that the patent system was ever intended to have this constraint. As best understood, this Examiner expects a patent claim to limit a method related to a processing that clearly has wide "practical applications" to only one or two such applications of the processing. As mentioned above, the intent of patent law is to grant the right to exclude the use of a patented method by others and would include all uses.

Taking the Examiner's attempt to limit the uses, such requirement would correspond to a requirement that an improvement providing memory reduction/processing efficiency for a word processing program, for example, be limited for only the application wherein the word processor is used for writing letters, for example, and would not protect the improvement when the word processor is used, for example, for writing business reports or academic papers. Applicants submit that there is no requirement in US patent law that require that the applicant artificially limit the claimed invention to specify which "practical applications" the method is protected by the patent and such artificial limitation contradicts the purpose of patent law to provide protection for all uses of the method, if that method has multiple uses.

In this example with the word processor improvement, the improvement would relate to the word processing application program itself, not to the applications for which the word processing application program could be used. Similarly, the present invention relates to the actual processing of a matrix operation on a machine, not to the practical applications that the matrix operation could possibly pertain.

That is, relative to the present invention, the method is directed to the real-world application of managing data in the computer to be presented for matrix processing. Although matrix processing has many real-world applications, as clearly explained in the disclosure, the "practical application" of the present invention is directed to the manner in which the machine processing the matrix procedure performs its functions, not the result that might be obtained by applying matrix theory and the matrix procedure being performed for any specific real-world problem or application.

Applicants further respectfully submit that the underlying flaw of the Examiner's position is that the analysis currently of record arbitrarily defines the present invention with this particular Examiner's preferred choice of wording, clearly in an attempt to characterize it as directed to non-statutory subject matter. That is, according to the Examiner's analysis, the reduction of memory space is the "intended use" of the conversion to full-packed data and the improvement of processing efficiency is the "benefit" of the method.

In response, Applicants submit that the conversion to the full-packed data format defines the method of the invention and the reduction in memory space/processing efficiency is inherently the result of this method. Even if the Examiner wishes to arbitrarily describe the memory reduction/processing efficiency as being the "intended use/benefit", there is nothing that precludes this "intended use/benefit" as also being the useful, concrete and tangible result of the method.

That is, "intended use/benefit" is not mutually exclusive to "inherent result." Indeed, Applicants submit that the words "intended use/benefit" are closely related to the word "result", in the sense that the Examiner uses these characteristics. Applicants respectfully submit that arbitrarily choosing to use the words "intended use" and "benefit" is an arbitrary preference of the Examiner and, when used as an alternative to "result", does not preclude the memory space reduction/ processing efficiency improvement as also being the "useful, concrete and tangible result" of the invention.

Stated slightly differently, the Examiner does *not* dispute that the present invention reduces memory and improves processing efficiency. Nor does the Examiner dispute Applicants' contention that such memory reduction/processing efficiency improvement is useful, concrete and tangible. Indeed, Applicants submit that such memory reduction/processing improvement is *inherently* a result of the described computerized method and is *inherently* useful, concrete and tangible.

Moreover, Applicants respectfully submit that, as a matter of law, this inherent result of the present invention, when claimed as a computerized process, is all that is necessary to satisfy the requirement for statutory subject matter and that it is irrelevant that a particular Examiner arbitrarily considers the inherent result of the computerized method as also being an intended use or a benefit of the method.

Finally, as Applicants submitted in the previous Amendment, since there is no mathematical algorithm being preempted by the method of the present invention, the “useful, concrete and tangible result” test applies only to the method claims, at most. The apparatus and Beauregard claims would not even be subject to such analysis and are clearly statutory.

Therefore, relative to claim 15, Applicants submit that this claim is clearly addressed to “[a] machine-readable medium tangibly embodying a program of machine-readable instructions executable by a digital processing apparatus .....” Such claims are “Beauregard claims”, after *In re Beauregard*, 53 F.3d 1583 (Fed. Cir., 1995), wherein the USPTO Commissioner conceded that such claims are indeed statutory subject matter because they are articles of manufacture. US Patent No. 5,710,578 to Beauregard, et al., issued on January 20, 1998.

Relative to claims 10, 13, and 14, these claims are directed to an apparatus and are, therefore, clearly directed to a machine, one of the four categories explicitly identified in 35 USC §101.

Relative to the method claims, as discussed during the recent telephone interview with the Examiner and particularly described in amended independent claim I, the present invention does indeed have the prerequisite practical application and tangible result (wherein “tangible” means “real-world”) because it permits a reduction in memory space for the data and an improvement in calculating the matrix operation.

Moreover, since the method steps are directed to the preliminary state of the machine performing the processing, Applicants submit that it is not even subject to the “useful, concrete and tangible result” test, since it is not directed to the actual processing of the matrix operation itself.

Therefore, the present invention is not merely manipulating data in the abstract nor even claiming the processing of the matrix mathematical operation in the abstract. Rather, as explained during the telephone interview, the present invention solves a long standing dense linear algebra problem of having two data structures (full and packed) for triangular (i.e., triangular or symmetric/Hermitian) matrices by eliminating the packed data structure, as explained on page 10 of the specification. The packed format uses half the storage but performs one to a hundred times slower than matrix processing algorithms written for the full format, whereas the full format uses twice the storage of packed and performs better or the same.

The present invention converts the packed or full data structure of symmetric or Hermitian/triangular matrix data into a hybrid full data structure (e.g., different from the standard full data structure). This hybrid full data structure saves half the memory storage compared to the full matrix data format and can be used with the faster full format processing, as modified to accommodate this hybrid full format.

In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw this rejection.

### **FORMAL MATTERS AND CONCLUSION**

The Examiner required incorporation of the words "machine-readable medium" into the specification. Although Applicants do not agree with this requirement, the wording is incorporated to expedite prosecution.

In view of the foregoing, Applicants submit that claims 1, 4-6, 10, 13-15, 18, 19, and 26-28, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview, using Applicants' representative's direct number (703) 761-2377 or the general number listed below.

Serial No. 10/671,933  
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The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Assignee's Deposit Account No. 50-0510.

Respectfully Submitted,



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**CERTIFICATION OF TRANSMISSION**

I certify that I transmitted electronically, via EFS, this revised Amendment under 37 CFR §1.116 to Examiner C. Do on August 20, 2007.



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